2.0 EXISTING CONDITIONS

2.1 ENVIRONMENTAL SETTING

2.1.1 General Site Description

The Columbia River and its tributaries drain an area of 219,000 square miles in seven western states and 39,500 square miles in British Columbia. Most of the basin in the United States is located in Washington, Oregon, Idaho and Montana. The Columbia River originates at Columbia Lake on the west slope of Rocky Mountain Range in British Columbia and flows west and south, draining into the Pacific Ocean between Washington and Oregon. Total river length is 1,214 miles (Bonneville Power Administration et al. 1994a).

The mid-Columbia River reach generally refers to the area from Grand Coulee dam downstream to the confluence with the Snake River near Pasco. The reach includes the federally-operated Grand Coulee and Chief Joseph dams, the five PUD projects (Wells, Rocky Reach, Rock Island, Wanapum and Priest Rapids) and the free-flowing Hanford Reach (Figure 1-1). Major tributaries entering the mid-Columbia River reach are the Okanogan, Methow, Entiat and Wenatchee Rivers.

The Wells Project is the first of five mainstem PUD dams below Chief Joseph dam. Wells dam is located at RM 515.8 and impounds Wells reservoir, which extends approximately 30 miles upstream to the tailrace of Chief Joseph dam. Wells reservoir has a surface area of 9,740 acres, a volume of 331,200 acre-feet, a mean depth of 34 feet, although the main channel is 100 to 150 feet deep in many places, and a shoreline length of approximately 100 miles. Several tributaries flow into Wells reservoir. These tributaries include the Okanogan and Methow Rivers. Other points of interest in the vicinity of the Wells Project include the Bridgeport Bar and Washburn Island (Figure 2-1).

2.1.2 Geology and Land use

The mid-Columbia River reach forms the boundary between the North Cascade Mountains to the west and the Columbia Plateau to the east. In the vicinity of the Wells Project, the river flows over mainly Paleozoic metamorphic and intrusive rocks. Further south, toward Rock Island dam, the river passes into the Columbia basalt group (Bonneville Power Administration et al. 1994a).

Land use in the mid-Columbia reach varies considerably from north to south. Rangeland predominates around Rufus Woods Lake, impounded by Chief Joseph dam, while irrigated cropland and orchards predominate the river corridor around the Wells Project. Below Rock Island dam land cover is mostly rangeland, with irrigated cropland on the east side of the river. Land bordering the Wells reservoir is owned by the Douglas County PUD. Land throughout the project reach is predominantly in private ownership, although there are a number of public land

Figure 2-1. The mid-Columbia River in the vicinity of the Wells Project.
PLACEHOLDER

units. Federal land in the project reach includes the Colville Indian Reservation in the north, the Okanogan and Wenatchee National Forests in sections between Wells and Rocky Reach dams, scattered tracts of Bureau of Land Management (BLM) land, the Yakima Firing Center between Wanapum and Priest Rapids dams, and the Hanford Reservation below Priest Rapids dam. There are also 13 state wildlife refuges and 7 state parks in the mid-Columbia region (Bonneville Power Administration et al. 1994a).

2.1.3 Water Quality

The Wells Project reach of the mid-Columbia River has been classified by the Washington Department of Ecology (WDOE) as "Class A" water. On a scale ranging from Class AA (extraordinary) to Class C (fair), Class A water is rated as "excellent". Regulations require that Class A water meets or exceeds requirements for substantially all uses. However, water quality in the mid-Columbia River occasionally does not meet state and federal water quality standards for certain parameters, e.g., total dissolved gas and water temperature.

The major contributors to water-quality effects in the mid-Columbia River include 1) nonpoint source pollution from agriculture runoff and irrigation return, 2) depletion of instream flows from diversions and 3) effects of impoundment, spill and flow regulation at hydropower projects. Irrigation return flows containing nutrients, sediments and pesticides can significantly impact the water quality of this reach. The primary water-quality impacts associated with the hydropower projects in the mid-Columbia River are increases in dissolved gases and alterations in water temperature.

Total Dissolved Gas

River water that contains high levels of total dissolved gas (TDG) can be harmful to fish. Total dissolved gas supersaturation often occurs during periods of high runoff and spill at hydropower projects, primarily because spill can cause significant air entrainment in spillway tailwaters. Fish and other aquatic organisms that are exposed to excessive TDG supersaturation can develop gas bubble trauma (GBT), a condition that is harmful. Total dissolved gas supersaturation in the mid-Columbia River system is well documented and has been linked to mortalities and migration delays of salmon (Beiningen and Ebel 1970; Ebel et al. 1975; Gray and Haynes 1977; Bonneville Power Administration et al. 1994a). Total dissolved gas supersaturation in the Columbia and Snake Rivers was identified in the 1960s and 1970s as a detriment to salmon, and those concerns have reappeared as management agencies have reinstituted spill as a means of aiding fish passage around Snake and lower Columbia River hydropower facilities (National Marine Fisheries Service 1995a).

Water Temperature

Water temperatures in the mid-Columbia River reach are similar to those elsewhere in the Columbia and Snake River systems (U.S. Army Corps of Engineers [USACE] 1993). The major effect of hydropower projects on the Columbia River has been to delay the time when thermal maximums are reached and when cooling begins in late summer (Bonneville Power Administration et al. 1994a). The thermal regime of the mid-Columbia River is largely influenced by releases from Grand Coulee dam, which is the main upstream deepwater storage project. Lake Roosevelt, the impoundment created by Grand Coulee can be quite warm, such that the temperatures of water entering the mid-Columbia River reach are already elevated (U.S. Army Corps of Engineers 1993). The mid-Columbia hydroelectric projects are run-of-river facilities with very limited capability for storage and flow regulation. In general, the very rapid flushing rate of the pool limits the potential warming that can occur.

2.1.4 Hydrology

The Columbia River basin is primarily a snow-fed system. Snow accumulates in the mountains from November to March, then melts and produces peak runoff in early June. In late summer and fall, the river flow drops and remains relatively low through April. Since about 1966, annual streamflow regimes in the Wells Project area have been affected by three different time periods of operation. These include the period from 1966 to 1973, as additional deepwater storage projects (i.e., Arrow, Libby, Mica) were being completed per the Columbia River Treaty; 1974 to 1982, as operations changed use of the available storage gained from these projects; and 1983 to 1995, when annual spring flow augmentation releases from these storage projects were recommended to aid migration of naturally produced and hatchery-origin juvenile salmonids in the lower Columbia River. The effect on the annual flow regime during these periods is indicated in Figure 2-2 based on average monthly total discharge at Wells dam.

These time periods were chosen because the Northwest Power Planning Council's (NPPC) Water Budget from Grand Coulee was first implemented in 1983. However, no releases specifically for Water Budget flow augmentation occurred in 1984 and 1985. Consistent annual flow augmentation releases from Grand Coulee began in 1986.

The flow regimes of these three periods indicate the influence of changes in storage and the shifts in operational objectives priorities. Prioritizing power generation and flood control objectives tended to result in "flattening out the hydrograph" by moving flow from spring, the period of peak natural runoff, into the fall and winter (i.e., 1973 to 1982). Placing higher priority on downstream fish migration trends toward releases that provide a slightly higher, more natural spring peak hydrograph (i.e., 1983 to 1995).

Figure 2-2. Average monthly flow at Wells dam during four different time periods of operation: 1927-1965, 1966-1972, 1973-1982, and 1983-present (U.S. Army Corps of Engineers).

PLACE HOLDER

As a run-of-river project, the Wells Project generally has little usable storage volume, and therefore cannot store or draft a significant volume of water. As such, flows at the Wells Project are primarily shaped by the operations at the Canadian and federal storage projects upstream, particularly Grand Coulee dam.

2.2 BIOLOGICAL SETTING

2.2.1 Life Histories of Plan Species

This HCP addresses the following anadromous salmonid fishes occurring in the mid-Columbia River system as plan species: spring (stream-type), summer and fall (ocean-type) chinook salmon *(Oncorhynchus tshawytscha)*, summer steelhead *(O. mykiss)*, coho salmon *(O. kisutch)* and sockeye salmon *(O. nerka)*. Life history information on the plan species specific to the Wells Project area are presented below.

Historically, chinook salmon entered the Columbia River continually from early spring through late fall. Due to overharvest and the construction of dams without fish passage, segments of the run were eliminated (Chapman et al. 1994a, 1995a). Timing of peak counts of adults passing upstream of dams is one method now used to divide the continuum into separate stocks. Another method for dividing the run into segments or stocks is through spawning areas. A window of time for egg deposition exists in each spawning area based on water temperature, and the timing of upstream migrating adults matches this window (Miller and Brannon 1982). Therefore, those adults that spawn in the upper reaches of tributaries, in the middle and lower reaches of tributaries, and in the mainstem rivers and lower reaches of tributaries can be divided into three races/demes. Because the adults of the race/deme that spawn in the upper reaches generally return past mainstem dams in the spring, they are known as spring (stream-type) chinook. Similarly, the race/deme that spawn in the middle and lower reaches of tributaries generally return past mainstem dams in the summer, and are known as summer (ocean-type) chinook salmon. Those that spawn in lower tributaries and the mainstem river arrive in the fall and are known as fall (ocean-type) chinook salmon (Meekin 1963; French and Wahle 1965; Chapman et al. 1982; Mullan 1987).

These arbitrary classifications are based on the date of arrival at mainstem dams (Table 2-1). These cutoff dates are established administratively and are not necessarily reflective of the origin of the adults (Chapman et al. 1995a). Summer and fall (ocean-type) chinook salmon are treated as one evolutionarily significant unit (ESU) since they cannot be electrophoretically separated (Chapman et al. 1994a), and also because the juveniles migrate as age 0+ (subyearlings) while spring (stream-type) chinook salmon juveniles migrate as age 1+ (yearlings).

Table 2-1. Upstream migration timing of anadromous salmonids at the Wells Project.

Species	Wells			WDFW
	10th[3]	50th[3]	90th[3]	counting dates
[1]Spring chinook	May 9	May 22	Jun 11	May 1 - June 28
[2]Summer chinook	Jul 4	Jul 22	Aug 13	June 29 - Aug 28
[2]Fall chinook	Aug 26	Sep 17	Oct 29	Aug 29 - Nov 15
Steelhead	Aug 4	Sep 17	Oct 19	
Sockeye	Jul 7	Jul 19	Aug 4	

[1] Stream-type
[2] Ocean-type
[3] 10th, 50th, 90th percentile of arrival times

Source: FPC 1995.

Spring (Stream-type) Chinook

Spring (stream-type) chinook salmon primarily use the Wells Project area as a migration corridor during their upstream and downstream movements. Most adult spring (stream-type) chinook salmon migrate upstream through the Columbia River to spawn after spending two to three years in the ocean (Chapman et al. 1995a; Columbia Basin Fish and Wildlife Authority [CBFWA] 1990). Upstream migrants pass Wells dam from late April through June with 90 percent passing from the second week of May through the first week of June (Figure 2-3). Between 1967 and 1997, adult spring chinook counts at Wells dam have averaged approximately 2,500 fish. Annual counts have fluctuated between 100 and 5,400 adults. Spawning occurs in upstream tributaries beginning in late July and continues through September, although the timing of peak spawning varies among tributaries (Chapman et al. 1995a). Wild populations of spring chinook salmon are found in the Methow River system upstream of the Wells Project (Chapman et al. 1995a; Mullan 1987).

Eggs hatch in late winter and early spring, and juveniles may migrate to rearing areas further upstream or downstream shortly following emergence. Most parr rear in freshwater for one year before migrating to the ocean (age 1+), but a small percentage migrate as subyearlings (age 0+) (Chapman et al. 1995a; Columbia Basin Fish and Wildlife Authority 1990; Palmisano et al. 1993). Outmigrating juveniles pass the Wells Project from late April through May (Mullan 1987).

Since 1970, hatchery production of stream-type chinook juveniles has increased, and the upriver spring chinook run is now comprised of about 60 to 70 percent hatchery adults (Palmisano et al. 1993; Bonneville Power Administration et al. 1994a). In 1993, stream-type chinook salmon hatchery juvenile releases to the mid-Columbia reach totaled 4,171,000 (Bonneville Power Administration et al. 1994a). Hatchery produced stream-type chinook smolts migrating past the Wells Project originate from the Winthrop and

Methow hatcheries.

Figure 2-3. Average arrival timing of adult spring (stream-type), summer and fall (ocean-type) chinook salmon at Wells dam from 1977 to 1994 (FPC 1995a).

PLACEHOLDER

Naturally produced stream-type chinook juveniles pass the Wells dam over a longer time period and are generally smaller than the hatchery produced juveniles. Naturally produced stream-type chinook juveniles originating from upriver areas were found to migrate downstream at lengths of 65 to 123 mm. Hatchery-reared stream-type chinook juveniles are generally released at a large size (117 to 178 mm) (Zook 1983; Mullan 1987).

Studies in the Columbia River Basin have shown juvenile chinook outmigrants actively feed and grow during their outmigration through reservoirs (Craddock et al. 1976; Dawley et al. 1986; Chandler, J., Idaho Power Co., unpublished data). Due to limited reach-specific data, a general assumption is that juvenile chinook outmigrant feeding behavior in the Wells reservoir is consistent with outmigrant behavior observed throughout the Columbia River. The rapid reservoir flushing rate and lack of shallow, backwater habitat suggests Lake Pateros is more characteristic of a flowing system than a lake system. Limited observation suggests that the residence time of juvenile stream-type chinook in Wells reservoir is short. Therefore, these juveniles are not lingering in Wells reservoir for rearing, but rather are migrating actively in mid-channel while in the reservoir.

Summer and Fall (Ocean-type) Chinook

For the purposes of the HCP, summer and fall (ocean-type) chinook salmon are treated as indistinguishable races/demes. However, when spawning is discussed, summer and fall chinook are separately identified and discussed. The fall chinook component are defined as those races/demes that spawn in the mainstem Columbia River, and in the extreme lower reaches of direct tributaries to the mainstem Columbia. The summer chinook component is defined as those stocks that spawn further upstream in the tributaries than the fall race, yet outmigrate as subyearling juveniles (age 0+), similar to fall chinook. Most summer and fall chinook salmon adults return to spawn after spending three or four years in the ocean (Peven 1992).

Summer and fall chinook salmon use the Wells Project area as a corridor during their upstream and downstream migrations. Ninety percent of adult summer and fall chinook pass Wells dam on their way to upstream spawning grounds from the beginning of July through the end of September (Figure 2-3). Between 1967 and 1997, adult summer and fall chinook counts at Wells dam have averaged approximately 6,500 and 2,400 fish, respectively. Over this time period, the number of summer chinook has fluctuated between 3,000 and 14,200 adults, while fall chinook have fluctuated between 770 and 4,800 adults. Summer chinook spawn in the mainstems of major tributaries to Wells reservoir, including the lowermost 50 miles of the Methow River, in the Okanogan River downstream of Lake Osoyoos, and in the Similkameen River below Enloe Dam (Chapman et al. 1994a).

Historically, the fall chinook component spawned in suitable areas up the Columbia River into the Canadian headwaters in the vicinity of Golden, B.C. (Chapman et al. 1994a). Currently, fall chinook are known to spawn near the Wells Project in the uppermost sections of Lake Pateros in the tailrace of Chief Joseph dam, as well as in the lower reaches of the Methow and Okanogan Rivers (Chapman et al. 1994a).

Meekin (1967) and Chapman et al. (1994a) suggested mainstem spawning continued in the Brewster Bar area following inundation by the Wells reservoir. Other surveyors have indicated potential deep water spawning near Bridgeport Bar, Washburn Island, and in areas near the Chief Joseph tailrace where substantial groundwater upwelling occurs (Hillman and Miller 1994; Chapman et al. 1994a; Swan et al. 1994; Bickford 1994). Based on this information, it is apparent that some unknown but significant amount of chinook production occurs in the mainstem river areas in Lake Pateros upstream of the Okanogan River to the Chief Joseph dam tailrace, as streambed hydraulics and substrate conditions allow.

Juveniles usually emerge in April and May and are displaced downstream within a few days to several weeks after emerging from the redd (Chapman et al. 1994a). Ocean-type chinook juveniles migrate in late summer as subyearlings, generally passing Wells dam from late June through early August (Chapman et al. 1994a). Juvenile ocean-type chinook salmon passing Wells dam result from both hatchery and natural production. Chapman et al. (1994a) reported that juvenile ocean-type chinook emigrating from tributaries to Wells reservoir in late spring and early summer ranged in size from 45 to 80 mm. In July, juvenile ocean-type chinook in the reservoir ranged in size from 100 to 110 mm (Chapman et al. 1994a). Unlike stream-type chinook, young ocean-type chinook are likely to spend several weeks rearing in Wells reservoir before outmigrating.

It is generally believed that juvenile ocean-type chinook salmon tend to use nearshore littoral habitat while stream-type juveniles tend to migrate in mid-channel (Ledgerwood et al. 1991b; Chapman et al. 1994a; Burley and Poe 1994). Ocean-type juveniles use shallow littoral areas shortly after emergence in April and May (Chapman et al. 1994a). Campbell and Eddy (1988) believe this partitioning of habitat is related to fish size and predator avoidance, with small fish using the slow velocity nearshore margin areas. They noted that chinook in the Lewis River began to move progressively offshore into faster water and established territorial feeding stations along the river bottom as they increased in size beyond 50 mm.

Ocean-type chinook migrants actively feed and grow during their outmigration through Lake Pateros. Studies downstream of the Wells Project have shown that their diet consists primarily of aquatic insects, with minor amounts of zooplankton (Becker 1970; Dauble et al. 1980). Rondorf et al. (1990) found that ocean-type chinook migrants fed primarily on *Diptera*, *Trichoptera*, *Daphnia*, *Corophium*, *Hymenoptera* and *Homoptera*. Zooplankton were the dominant food item in embayments, while insects were dominant in littoral and limnetic areas. Preference was shown for terrestrial insects in littoral areas and embayments. These data also support the conclusion that aquatic insects comprise the primary prey items for juvenile salmonids in the mid-Columbia reach due to limited reservoir productivity.

Hatchery production of summer chinook occurs at the Wells, but releases have only supplemented the total summer and fall chinook runs. Chapman et al. (1994a) estimate that about 6 percent of the summer and fall run fish are of hatchery origin in the mid-Columbia reach. Naturally-produced fish comprise the majority of adults returning to the mid-Columbia reach (Chapman et al. 1994a).

Summer Steelhead

Summer steelhead use the Wells Project area as a corridor for juvenile and adult migration. The majority of summer steelhead returning to the mid-Columbia River are of hatchery origin, but some natural production occurs in tributaries to Wells reservoir, including the Okanogan, Similkameen, and Methow Rivers (Chapman et al. 1994a). Adult steelhead migration is much more protracted than that of other anadromous salmonids in the Columbia River. Adult summer steelhead begin arriving at Wells dam in May and 90 percent pass from the beginning of August through the third week of September (Figure 2-4). Between 1967 and 1997, adult summer steelhead counts at Wells dam have averaged 5,756 fish and ranged between 740 and 20,600 adults. Returns over this period peaked in the 1980s following hatchery supplementation.

In the Columbia River basin, naturally produced steelhead juveniles generally emerge from the gravel from July through September. After emergence, juveniles move downstream into overwintering habitats (Chapman et al. 1994b). Most parr rear in freshwater for two years, but the duration of freshwater residence can range from one to seven years (Columbia Basin Fish and Wildlife Authority 1990; Peven 1992). Peven et al. (1994) found that about 90 percent of wild steelhead juveniles in samples taken at Rock Island and Rocky Reach dams were two- and three-winter residents. Hatchery smolts are released as yearlings. Both hatchery and naturally produced steelhead pass Wells dam in May (McGee 1984). The size of steelhead smolts passing Wells dam was reported as ranging from 127 to 203 mm for naturally produced and 152 to 254 mm for hatchery smolts (Zook 1983). Juvenile steelhead migrate actively in Wells reservoir and residence time in Lake Pateros is short (McGee 1984).

No information is available about the feeding habits of steelhead juveniles in the mid-Columbia River reach. Steelhead juveniles in Lower Granite reservoir on the Snake River fed primarily on *Chironomidae*, and also took minor amounts of *Homoptera*, *Ephemeroptera*, *Trichoptera* and *Plecoptera* (Chandler, J., Idaho Power Co., unpublished data). Of over 100 stomachs examined, only two contained an unidentified fish. It may be reasonable to assume the dietary behavior of steelhead juveniles is the Snake River reservoirs is typical of steelhead juveniles in the mid-Columbia reach.

Figure 2-4. Average arrival timing of adult steelhead at Wells dam from 1977 to 1994.
PLACEHOLDER

Coho Salmon

Historically, coho salmon migrated through Wells reservoir to spawning areas in several tributaries to the mid-Columbia River . The endemic stock has been considered extinct in the upper Columbia River regions including upstream of the Wells Project since the 1940s.(Mullan 1984; Columbia Basin Fish and Wildlife Authority 1990). The State of Washington does not currently recognize any natural coho stock in the mid-Columbia reach (Washington Department of Fisheries et al. 1993). To the extent that coho are reintroduced, are residual from prior hatchery programs, or are included in future hatchery programs, the mitigation and off-site compensatory measures of this plan are intended to include that species. Historical and biological data on coho in the mid-Columbia reach are included when available.

Sockeye Salmon

Sockeye salmon use the Wells Project area as a corridor for juvenile and adult migration. Adult sockeye pass Wells dam on their way to spawning grounds upstream of Lake Osoyoos on the Okanogan River . Adults arrive at the dam from June through September, and 90 percent arrive from early July through early August (Figure 2-5).

Between 1967 and 1997 the counts of adults passing upstream of Wells dam have averaged 32,767 fish. However, returns of sockeye are highly variable and have ranged between approximately 1,650 and 113,300 fish since counts originated in 1967. These fluctuations are typical for sockeye production and represent strong and weak year classes. The abundance of natural stocks of sockeye fluctuates radically in a cyclical dominance pattern of four years' duration (Larkin 1983).

Sockeye fry emerge in March and April in the Okanogan system (Allen and Meekin 1973). Immediately after emergence, fry move into freshwater lakes (Chapman et al. 1995b; Columbia Basin Fish and Wildlife Authority 1990). Newly emerged fry feed primarily in the littoral zone of lakes on Chironomidae larvae, and gradually shift to pelagic feeding on zooplankton, especially *Bosmina, Cyclops* and *Daphnia spp.,* as they mature (Groot and Margolis 1991). Sockeye salmon migrate as smolts after spending one to three years in their nursery lakes (Chapman et al. 1995b). Juvenile sockeye salmon passing Wells dam originate from upstream spawning areas and hatchery releases into Lake Osoyoos . Sockeye salmon juveniles primarily pass Wells dam during the month of May (Kudera et al. 1992). The size of juvenile sockeye passing the project ranges from 76 to 128 mm (Zook 1983).

Sockeye juveniles actively migrate during their downstream migration, similar to yearling chinook and steelhead (Chapman et al. 1995b). Rates of travel up to 25 miles per day have been measured from the mid-Columbia River to Bonneville dam before most dams were in place (Chapman et al. 1995b). No information is available regarding the feeding habits of sockeye juveniles in the mainstem reservoirs of the Columbia River basin. It is expected that they feed on *Chironomidae* larvae and zooplankton such as Cladocera during their outmigration.

Figure 2-5. Average arrival timing of adult sockeye salmon at Wells dam 1977 to 1994.
PLACEHOLDER

Hatchery production of sockeye salmon is currently conducted at the Cassimer Bar hatchery and Lake Osoyoos net pens. The goal for releases of juvenile sockeye salmon from these facilities is 129,500 fry annually (Washington Department of Fish and Wildlife 1995).

2.2.2 Distribution of Anadromous Salmonids

The pattern of distribution of fish, particularly juvenile salmonids, in Wells reservoir is a potentially important factor in determining the effects of the Wells Project on downstream migrants. Horizontal and vertical distribution of juveniles in the immediate forebay is a critical issue for downstream dam passage. The distribution of juveniles as they approach the Wells dam facilities through the downstream end of the reservoir affects the pattern of turbine, bypass or spillway entrainment. A discussion of the horizontal, vertical and diel distribution in the immediate forebay is presented in Section 3.2.1 of this document. Information on the pattern of diel movements past Wells dam is also presented in Section 3.2.1.

Horizontal distribution of spring and summer migrating juveniles in the lower three miles of Wells reservoir was described by McGee et al. (1983) and McGee (1984). The authors observed that yearling chinook, as well as sockeye and steelhead smolts, were more numerous in catches from the left (i.e., east) shoreline of the Wells reservoir.

Summer purse seining (June - July) collected primarily subyearling chinook salmon ranging in length between 51 and 159 mm and averaging 94 mm. As was the case for the yearling fish, the sets along the left (east) shoreline yielded relatively more fish than other sampling stations.

Hydroacoustic data collected during operation of the Wells juvenile bypass (see Section 3.2.1) generally indicate that fish passage rates and FPE are lowest on the left side of the hydrocombine and higher toward the center and right side of the structure. Although the index-seining data indicate that outmigrants prefer the left side of the lower portions of the Wells reservoir (McGee 1984), the hydroacoustic data indicate that the fish are becoming redistributed in the immediate vicinity of the project. The mechanisms responsible for this apparent horizontal redistribution are currently undescribed, but may be related to forebay bathymetry, forebay hydraulics or other factors.

There are no data available on the depth distribution of juvenile salmonids in the Wells reservoir. Information on vertical distribution in the Wells Project area is limited to hydroacoustic data for the Wells forebay immediately upstream of the dam and is summarized in Section 3.2.1.

2.2.3 Species Not Included in the Plan

Other aquatic and terrestrial species are not covered by the HCP, except to the extent that their activities may impact the plan species. These species are discussed generally in the following subsection.

Other Fish Species

Dell et al. (1975) found 18 resident species using the Wells pool. The most abundant species were suckers (38% of fish caught; unspecified spp.), northern squawfish (23%), redside shiners (14%), chiselmouth (10%), sculpins (5.5%; unspecified spp.), peamouth (4%) and mountain whitefish (3%). The other species comprised less than 3 percent of the number caught. Kokanee, a resident form of sockeye salmon, are commonly entrained through Grand Coulee dam (Bonneville Power Administration et al. 1994a) and can be locally abundant in Wells reservoir. Juveniles or adults from small resident fluvial or adfluvial populations of bull trout in the Methow River drainages (Brown 1992) may occasionally drift downstream into Wells reservoir as part of their natural life cycle (Dell et al. 1975). Adult Pacific lamprey were counted at the adult fishway counting facilities at Wells dam in 1995. They were likely present in previous years but were not counted. Few adult lamprey were observed passing the project prior to early August, and subsequent daily counts were low (Klinge, pers. comm., 21 September 1995). Adult lamprey probably pass Wells dam from mid-July through late October based on Rocky Reach dam counts (Peven, pers. comm., 14 September 1995).

Other Aquatic Animal Species

In addition to the numerous fish species discussed above, there are a variety of vertebrate and invertebrate species that utilize the mid-Columbia River as habitat for all or a significant part of their life cycle. These include species of molluscs, reptiles and amphibians. Those species known to be present in the mid-Columbia reach and may occur in some areas covered by the HCP are identified in Table 2-2.

Several plant species that are present either in the mid-Columbia River or along the shoreline are dependent on the river as habitat or use it as an essential habitat component (e.g., water table elevation). Those aquatic plants known to occur in at least portions of the mid-Columbia River and along its shoreline are identified in Table 2-3.

Terrestrial Resources

Resident and wintering waterfowl are one of the most abundant wildlife resources in the plan area. Common species include Canada geese and numerous duck species. Osprey, northern harrier, barred owl, bald eagle and other raptors are also found in and around riparian and wetland areas in the plan area. Riparian and wetland areas also provide habitat for several species of game and insect-eating species of birds. Shorebirds such as herons, gulls and terns feed and nest in shallow water areas, embayments, shorelines, riparian areas and wetlands. Mammals found in the plan area include the black bear, mountain lion and bobcat, as well as several species of deer and other ungulates.

Table 2-2. Aquatic animal species known to be present in areas of the mid-Columbia River.

Common name	**Scientific name**	**Status**
California floater	*Anodonta californiensis*	Uncommon
Giant Columbia River limpet (shortface lanx)	*Fisherola nuttalli*	Uncommon
Great Columbia River spire snail (pebble snail)	*Fluminicola columbiana*	Uncommon
Long-toed salamander	*Ambystoma macrodactylum*	Uncommon
Pacific treefrog	*Hyla regilla*	Uncommon
Red-legged frog	*Rana aurora*	Uncommon
Painted turtle	*Chrysemys picta*	Uncommon

Source: BPA et al. 1994a.

Table 2-3. Aquatic plants known to occur in the mid-Columbia River and along its shoreline.

Common name	**Scientific name**	**Status**
Lady fern	*Athyrium filix-femina*	Common
Sword-fern	*Polystichum spp.*	Common
Woodsia	*Woodsia oregana*	Common
Quaking aspen	*Populus tremuloides*	Common
Black cottonwood	*Populus trichocarpa*	Common
Weeping willow	*Salix babylonica*	Common
Willow	*Salix spp.*	Common
White alder	*Alnus rhombifolia*	Common
Water birch	*Betula occidentalis*	Common
Miner's lettuce	*Montia perfoliata*	Common
Douglas maple	*Acer glabrum var. Douglasii*	Common
Purple loosestrife	*Lythrum salicaria*	Noxious weed
Red-osier dogwood	*Cornus stolonifera*	Common
Common cat-tail	*Typha latifoli*	Common
Giant helleborine	*Epipactis gigantiea*	Sensitive/rare

BPA et al. 1994a.

2.2.4 Listed, Candidate and Other Species of Concern

The USFWS has identified 22 federally listed or candidate fish and wildlife species and nine plant species that might be present in the mid-Columbia reach, including the Wells Project area.

2.3 STRUCTURAL SETTING

Wells dam was the eleventh dam built on the U.S. portion of the Columbia River, with first power generation occurring in 1967. In addition to the standard components of a hydroelectric facility, Wells dam has many fish passage and protection features for both upstream and downstream migrants. Further, as compensation for fish losses resulting from the Wells Project, the DCPUD funds two production facilities and one experimental fish production facility. Descriptions of the physical features of the Wells dam fish-related facilities are presented in the following subsections and summarized in Table 2-4. Details on the facility operations are presented in Section 2.4 of this document.

2.3.1 Power Generating Facilities

Until the early 1990s, Wells dam was the only dam in North America designed as a hydrocombine. While traditional dams have separate powerhouse and spillway structures, the Wells hydrocombine integrates the two by placing the spillway openings in unused space between the generators. This design approach was originally chosen to reduce the footprint of the combined powerhouse and spillway structures, thereby reducing the amount of concrete (and cost) needed to reach the limited amount of bedrock at the site (Figure 2-6).

The dam spans 4,460 feet, with the hydrocombine structure comprising 1,130 feet. The original river channel ran through what is now the east (left) embankment (Figure 2-6). A large amount of overburden was excavated in order to construct the hydrocombine on bedrock. Consequently, both the forebay and tailrace are at lower elevations than typical reservoir topography immediately upstream and downstream.

Generating facilities consist of 10 Kaplan turbines (Figure 2-7). Turbine Units 1 to 7 were initially started and accepted from the manufacturer in 1967, while Units 8 to 10 were started and accepted by January 1969. The total nameplate capacity of the generating units is 774.3 MW, and the total hydraulic capacity of the powerhouse is 200,000 cfs. The unit turbine rating is 120,000 hp at 64 feet net head and 85.7 rpm.

Table 2-4. Wells dam structural setting summary.

Generating facilities			
Dam length (feet)			
Hydrocombine	1,130		
East embankment	1,030		
West embankment	2,300		
Total	4,460		
Start of operations	1967		
Powerhouse nameplate capacity	774.3 MW		
Powerhouse hydraulic capacity	200,000 cfs		
Turbine quantity and type	10 Kaplan		
Unit turbine rating	120,000 hp at 64 feet net head and 85.7 rpm		
Spill gate quantity and type	11 leaf gates with upper and lower segments		
Spill gate dimensions			
Upper leaf	46 feet wide by 35 feet high		
Lower leaf	46 feet wide by 30 feet high		
Ice and debris sluice gates	1 each at S2 and S10, 23 feet wide by 14 feet high		
Spillway design	Controlled ogee; no energy dissipation features		
Important elevations for normal operations	Normal	Maximum	Minimum
Reservoir elevation	780.5	781.0	771.0
Tailwater elevation	710.5	724.0	704.5
Gross head (feet)	70.0	75.5	56.5
Spillway crest elevation	716.0	NA	NA
Spill height (spill crest to TW surface) (feet)	5.5	-48.5	11.5
Spillway lip elevation	691.0	NA	NA
Rock trap elevation	622.0	NA	NA
Tailrace depth (TW surface to rock trap) (feet)	88.5	142.5	82.5
Upstream fish passage and protection facilities			
Number of fishways	2		
Fishway width	12 feet		
Fishway slope	1:10		
Number of pools	73		
Endwall entrances	1 per ladder		
Sidewall entrances	1 per ladder		
Low level fixed orifice entrances	1 per ladder, open only when sidewall entrances are closed		
Attraction gallery	Located below spillway lip for full width of tailrace		
Maximum attraction flow	5,000 cfs		
Downstream fish passage and protection facilities			
Smolt bypass system	Surface attraction system, first full operation in 1989		
Number of units	5		
Baffle opening	16 feet wide by 73 feet high		

Typical unit flow	2.2 kcfs
Bypass outlet route	Bottom spill at S4, S6, S8; top spill at S2, S10
Aerial predator control wiring	25 feet on center full width of tailrace

Source: DCPUD 1994; Bechtel 1963.

Figure 2-6. Transverse cross section of the river channel in the vicinity of the Wells dam (Source: Patrick 1970).

PLACEHOLDER

Figure 2-7. Wells dam fish passage and protection facilities.
PLACEHOLDER

There are three intakes for each turbine unit, measuring 26 feet wide by 58 feet high. In the event of an emergency where it is necessary to shut off the flow to a turbine, turbine intake bulkheads can be installed through a submerged gate slot in the turbine intake. The bottom of the turbine intakes are located at 135 feet below the normal water surface elevation. Because of the excavation that was required during construction of the dam, the turbine intakes are substantially deeper than the reservoir bed upstream from the hydrocombine. The excavation extended approximately 500 feet upstream from the center of the hydrocombine, to the point where the normal water depth is about 60 feet deep.

Each turbine is equipped with a runner 24 feet in diameter, the hub being 9.5 feet in diameter. The blades of the runner can rotate 12.1 degrees, between angle settings of 20.0 degrees and 32.1 degrees. The centerline of each runner is approximately 24 feet below the typical tailwater elevation. These runners were installed between 1988 and 1990, following a six-year period during which the original runners had been operated in a welded, fixed-blade condition to reduce the risk of failure.

Water exits each turbine via a draft tube, providing a smooth transition from vertical to horizontal flow. At Wells, the bottom of the draft tube is located 95 feet below the normal tailwater elevation. The limits of excavation conducted during construction of the dam extend approximately 1,400 feet downstream from the center of the hydrocombine, to the point where the normal water depth is about 15 feet deep.

The hydrocombine structure contains 11 spill bays interspersed between the generating units. Each spill bay is 46 feet wide, for a total spillway width of 506 feet. Water releases through the spillway are controlled by vertical gates. Each spill bay has two gates, a bottom leaf 30 feet high, and a top leaf 35 feet high. Normally, spill is achieved by raising the lower leaf to the height necessary to achieve the desired spill discharge. The top gates are used only after the bottom gates have been fully opened, which should be necessary only in extreme flood events. There are also two flap gates 23 feet wide by 14 feet high located at the top of the gates in Spill Units S2 and S10. They are used to pass ice and debris over the dam.

Because of the hydrocombine design, the spillway intakes are located directly above the turbine intakes (Figure 2-8). Spill Units S2 to S10 each have three intakes, while Spill Units S1 and S11 have two intakes each. The bottom of the spillway intakes are located 73 feet below the normal water depth.

The discharge side of the spillway is a controlled ogee design. The spillway crest is 5.5 feet above the normal tailwater elevation. The normal water depth above the spillway lip is 10 feet, but the draft tube location beneath the spillway lip extends the depth of the tailwater to 88.5 feet.

Figure 2-8. Schematic view of Wells dam intakes (Source: USDOE et al.1993).
PLACEHOLDER

2.3.2 Upstream Passage and Protection Facilities

The upstream passage facilities at Wells dam consist of identical but mirror-image left and right bank fishway facilities. Each fishway is a conventional staircase-type fish ladder 12 feet wide and comprised of 73 pools (Figure 2-9). Water is directed from one pool to the next via overflow weir sections 7 feet wide and through two 18-inch by 15-inch submerged orifices. About 1 foot of hydraulic head is dissipated at each weir in each of the lower 56 pools. In the upper 17 pools, the drop can range from 6 inches to 1 foot to accommodate the 10-foot fluctuations that may occur due to power generation.

At the bottom of each fishway is a portion of the endwall structure which serves as a fish attraction and collection chamber. There are three entrances into each collection chamber (Figure 2-10). The main side entrance and the downstream entrance are each 8-foot-wide vertical slots with vertical mitre gates to control the amount of opening. Below the side entrance is a fixed orifice type entrance, located at the end of a fish passage gallery extending the full width of the hydrocombine beneath the spillway lip. The orifice entrance and gallery are intended for use only when both the turbines and spillway are operating.

Provisions for sorting fish and collecting broodstock are contained at Pool 40 of each fishway. A removable picket barrier diverts fish from the ladder into a denil flume and then into a pool. In the west fishway, a false weir induces fish to exit the pool into a sorting flume that directs fish either to a 30-inch-diameter pipe leading to the hatchery spawning area, or on to the upstream side of the ladder. In the east fishway, the false weir leads to a flume to a station for loading fish transport vehicles.

Fish counting facilities are contained in Pool 64 of each fishway. The main features include an observation window into the fish ladder, a telescoping gate that forces fish to swim closer to the window, and a bypass gate to control the flow velocity past the window.

The exit from the fishway into the reservoir is located at the upstream corner of the endwall on the face toward the bank of the river. A slide gate allows the exit to be closed. Attraction water for the fishway entrances is provided by two turbine-driven pumps capable of withdrawing 1,200 to 2,500 cfs of water from the tailrace and introducing it into the collection chamber and lower portion of the fishway. Additionally, there are four fish attraction jets in a vertical plane near each side entrance that are supplied through gravity flow from the reservoir. The upper three jets are operated with 80 to 90 cfs each whenever they are submerged and the side entrance is open. The lowest jet is used to discharge approximately 125 cfs into the fish attraction gallery whenever the lower fixed orifice entrance is used.

Figure 2-9. Wells dam fishway plan at elevation 733 msl (Source: DCPUD 1993).
PLACEHOLDER

Figure 2-10. Schematic view of Wells dam right bank fishway (Source: Loder and Erho 1970).
PLACEHOLDER

2.3.3 Downstream Passage and Protection Facilities

In 1989, a permanent juvenile bypass facility was completed at Wells dam. The system is based on a surface collector concept that utilizes barriers placed in spillway intakes to increase flow velocities in the upper water column of the forebay. It is postulated that the increased velocities attract smolts, and that once entrained in the attractant flow they pass readily through the baffle opening (Johnson et al. 1992). Fish that enter the baffled spillway pass the dam in bypass flow instead of turbine flow (Figure 2-11).

The smolt bypass system is comprised of five individual bypass units, installed in alternating spill bays S2, S4, S6, S8 and S10. Each bypass unit was formed by modifying a spill bay with baffles, sidewalls and gate slot plugs. Baffles inserted into trash rack guides in the modified spill bays reduce the open area and thereby increase flow velocity into the bypass units. Side walls installed between the pier noses and the turbine pit walls on each side of a spill bay prevent water from flowing between adjacent spill bays. Gate-slot plugs prevent flow between turbine intakes and the bypass unit.

The design of the baffle opening was decided after many years of testing different baffle configurations (Johnson et al. 1992). The installed system contains vertical slot baffle openings 16 feet wide by 73 feet high, which result in an average velocity through the opening of about 2 feet per second. Once fish are past the baffles, their passage through the smolt bypass system is identical to their passage over the spillway.

Downstream migrants passing the dam may be temporarily disoriented, whether passage occurs through turbines or over the spillway. To protect these fish from extensive predation by birds, aerial predator control wiring has been installed downstream of the dam over the tailrace. The wiring consists of cable strung approximately 25 feet apart for the first 200 feet downstream and 50 feet apart for the subsequent 400 feet.

2.3.4 Fish Production Facilities

Provisions of the FERC license and the 1990 Settlement Agreement require the DCPUD to provide hatchery-based compensation for losses of salmon and steelhead resulting from the Wells Project (Federal Energy Regulatory Commission 1990; Douglas County Public Utility District 1969, 1972, 1982). The DCPUD has consequently funded the design, construction and operation of two major fish production facilities: Methow hatchery and Wells fish hatchery. In addition, the Cassimer Bar hatchery was started in 1992 as an experimental facility for sockeye production. The facility, located near the mainstem Columbia and the confluence of the Okanogan River, consists of incubation facilities plus vinyl raceways for juvenile rearing and adult holding. A satellite net pen facility is also available at Lake Osoyoos for juvenile acclimation and rearing.

Figure 2-11.   Wells hydrocombine front and side views of downstream fish passage/protection bypass unit, showing horizontal and vertical baffle openings and attractant flows.

PLACEHOLDER

The Methow hatchery was constructed in 1991 to accommodate the enhancement of spring chinook in the Twisp, Chewuch and Methow Rivers. The main facility, located on the Methow River, contains isolation incubation facilities, 24 starter troughs, 12 raceways, 3 adult holding raceways and a growout/acclimation pond. The site is supplied by four wells capable of delivering 9 cfs and a surface water supply providing an additional 9 cfs. By agreement, the Methow Hatchery has the ability to use a 7 cfs portion of the USFWS water right for the Winthrop NFH. An adult trap for the Methow race/deme is located slightly upstream of the site. There are also two satellite facilities located on the Twisp and Chewuch Rivers. Each satellite contains an adult trap, an acclimation pond and a 3 cfs surface water supply for the pond (Bonneville Power Administration et al. 1994a).

The Wells fish hatchery was constructed in 1967 as a 6,000-foot-long spawning channel and a five-acre rearing pond. In the 1970s, the spawning channel concept was abandoned and the site was renovated to consist of a hatchery building with incubation facilities, 12 raceways, four rearing ponds of various sizes and adult capture and holding facilities. Water for the facility is supplied from 13 wells providing up to 29 cfs of groundwater, and up to 76 cfs gravity flow water from the Columbia River, most of which is used for the adult capture and holding facilities (Bonneville Power Administration et al. 1994a).

2.4 OPERATIONAL SETTING

2.4.1 Dam and Reservoir Operations

System-wide Integration of Operations

Flows through the Wells Project are primarily regulated from Grand Coulee dam in accordance with the Federal Columbia River Power System and the Mid-Columbia Hourly Coordination Agreement. Like all mid-Columbia projects, Wells dam is controlled from a dispatch center located in Ephrata, Washington. The general objective of this central coordination is to optimize power production while at the same time enhancing non-power uses of the mid-Columbia hydropower resources. Factors influencing the ability of the DCPUD to mitigate impacts to listed species include the many agreements, regulations and programs that determine flow into the mid-Columbia River reach from Grand Coulee dam. The Canadian Treaty and the related Non-Treaty Storage Agreement (NTSA) control the timing of flow into this reach. Since the NPPC established its first Fish and Wildlife Program in 1982, the Water Budget and other NPPC programs have played an increasing role in controlling flows in the mid-Columbia River reach. Similarly, the 1988 Vernita Bar Settlement Agreement (VBA) established minimum stream flows in the main fall chinook spawning grounds in the Hanford Reach of the Columbia River downstream of the Mid-Columbia Projects. Since implementation of the VBA, river flows have increased annually during the November to January period. In addition, the ESA listings of Snake River chinook and sockeye salmon, and Kootenai River white sturgeon have had a significant effect on mid-Columbia flows.

Project Operations

The main factor governing turbine operations and total plant discharges at Wells dam is the power demand specified by the Hourly Coordination Agreement. Discharges are normally modulated to match the shape of the power demand, taking into account discharge and spill requirements for other purposes such as fish passage, flood control and recreation. At Wells, power demands can be more than twice as high during the day than they are at night. Consequently, there is a high likelihood that several of the 10 turbines will go through one or more on-off cycles during a typical 24-hour period. Evidence of these cycles can be noted in the minimum and maximum daily discharges reported in Table 2-5. Generally, there is prioritization to the order in which turbines are turned on and off at Wells. However, attempts are made to distribute turbine usage so that all units receive approximately the same wear.

Table 2-5. Project discharge (kcfs) for Wells dam, April through August, 1992.

	PROJECT DISCHARGE (kcfs)				
	April	**May**	**June**	**July**	**August**
Minimum daily average	33.2	62.4	31.5	38.3	33.0
Maximum daily average	153.3	155.2	157.0	147.1	118.0
Average hourly discharge	96.7	107.1	117.3	98.7	85.0
15-year average	115.1	133.2	138.1	115.5	97.4
Percent of 15-year average	84	80	85	85	87

Source: Kudera and Sullivan 1993.

The water surface at the forebay of the Wells dam is designed for a normal operating range of 10.0 feet, between elevations 781.0 and 771.0. The typical elevation of the forebay water surface is assumed to be 780.5 for the purposes of this HCP.

Wells dam has a total turbine discharge capacity of 200,000 cfs. On occasions when river flows at Wells exceed the turbine discharge capacity plus any additional nonpower needs for discharge, it becomes necessary to provide forced spill. Forced spill is typically conducted by raising a bottom leaf segment of a spill gate. Forced spill events have decreased considerably since implementation of the Canadian storage facilities in the mid-1970s and since startup of the Wells smolt bypass system in 1989. Further details of the bypass system flows are described Section 2.4.3.

2.4.2 Adult Fish Passage Operations

The two Wells dam adult fishways are operated all year, following criteria specified in the 1990 Settlement Agreement. For the purpose of operation and maintenance, the period from May through November is considered the primary passage period for adults at Wells. Between December and April, when adult migration activities are minimal, one or the other fishway may be briefly shut down to conduct an annual inspection and routine maintenance.

Both fishways are equipped with counting stations for monitoring adult passage at Wells dam. The stations are operated from May through November 15 each year, collecting information on adult chinook, steelhead, coho and sockeye passage. Other species of non-salmonid fish passing through the fishway are also counted.

Criteria for operating the fishways include specifications for water depth, head differential, entrance gate settings and attraction jet operation (Table 2-6). Since 1994, these criteria have been used throughout the year, replacing an earlier mode of operation which used less stringent criteria during winter months. Current criteria call for two of the three entrances at each ladder to be open at all times. The end entrance is always open. The efficacy of side entrance opening is being evaluated . Operation of the attraction jets is dependent on both entrance settings as well as tailwater elevation. Typically, the upper attraction jets located at elevations 700 and 708 are operated at the same time.

Flows through the fish ladder are controlled to maintain a minimum flow of 48 cfs. Depending on the reservoir elevation, between 31 and 44 cfs enters the ladder via gravity flow through the fishway exit. An additional 4 to 17 cfs is introduced into Pool 56 using gravity flow. Fish attraction pumps add approximately an additional 5 cfs per ladder.

When spill operations are required at the dam during the adult migration period, the DCPUD attempts to direct spill to those areas that have the least impact on fishway attraction and utilization, while still maintaining essential water control functions of dam operations. Generally, adult passage spill is implemented in a crowned pattern. During those periods when both adult and juvenile passage criteria are in effect, the juvenile criteria have precedence.

Table 2-6. Operating criteria for Wells dam fishways.

Staff gage locations	Upstream and downstream of all entrances and exit trashracks, and at convenient locations for viewing along the ladder.
Water depth over ladder weirs	1.0 - 1.2 ft
Head on fishway entrances	1.0 - 2.0 ft (1.5 ft preferred)
Maximum trashrack water surface differential	0.3 ft
End wing gate settings:	
Spill less than 80 kcfs	6 ft
Spill greater than 80 kcfs	8 ft
Side wing gate settings:	
Spill less than 80 kcfs	4 ft
Spill greater than 80 kcfs	Closed
Low level fixed orifice entrance settings	Open whenever side wing gate is closed
Attraction jet criteria:	
Lower jet (elevation 673)	On whenever low level fixed orifice entrance is open
Upper jets (elevation 700, 708 and 717)	On whenever submerged by tailwater. Only two of the four orifice jets will be operating at any one time.

Source: FERC 1990; DCPUD 1993.

2.4.3 Juvenile Fish Passage Operations

In 1987, the Mid-Columbia Coordinating Committee (MCCC) agreed to replace the interim measure of bypass spill at Wells dam with the operation of the smolt bypass system then under development. Four of the five planned bypass units were already in place during 1987 and 1988, and the fifth spill bay was operated as though it had already been modified. In 1989, the fifth bypass unit was installed and operation of the complete system commenced. Since 1990, timing of the operation of the smolt bypass system has been managed by representatives of the Wells Coordinating Committee (WCC), following terms and conditions of the 1990 Settlement Agreement (Federal Energy Regulatory Commission 1990).

The smolt bypass system at Wells is prepared for operation each year at least two weeks prior to the preseason forecast of the beginning of juvenile migration. It remains in place for at least two weeks after the juvenile migration period ends. In between these dates, the bypass system is available to operate continuously, 24 hours per day, at the direction of the WCC. Historically, the bypass operates less than 24 hours per day when juvenile salmonid numbers are low as indicated by the hydroacoustic index. In 1994, bypass operation started on April 12 and ended on August 11 (Klinge, pers. comm., 27 September 1995).

During the juvenile migration period, at least one of the five individual bypass units (S2, S4, S6, S8 and S10) is in operation at all times, even if no turbines are operating. When a turbine is operated, the adjacent bypass unit is operated at the same time (Table 2-7).

Table 2-7. Turbine and associated bypass unit operation at Wells dam.

Turbines Operated	Bypass Units Operated
1 and/or 2	S2
3 and/or 4	S4
5 and/or 6	S6
7 and/or 8	S8
9 and/or 10	S10

On occasions when the Chief Joseph Dam Uncoordinated Discharge Estimate is 140 kcfs or greater for the following day, all five bypass units are operated continuously for 24 hours regardless of turbine operation.

Bypass units are turned on by opening the spill gate associated with the unit. For units S4, S6 or S8, this is accomplished by opening the lower leaf of the spill gate 1 foot, resulting in a bottom spill bypass flow of 2.2 kcfs per unit. Units S2 and S10 have the option of spilling over the ice and debris sluice gates (except when the Wells pool is very low) or using bottom spill. The sluice gates are the preferred method of spill for these units, at typical discharge levels of 1.6 to 2.1 kcfs. Based on this mode of operation, the daily bypass flows at Wells dam have averaged around 6 percent of total project discharge (Kudera et al. 1992; Kudera and Sullivan 1993).

Start and end dates for operation of the Wells smolt bypass system are determined in part from data collected as part of the Annual Passage Monitoring Plan. Hydroacoustic sampling of fish passage begins two weeks before the forecasted beginning of the migration period. Data are used to develop daily in-season indices of relative fish abundance, which then may be used by the Wells Bypass Team to adjust bypass system operation.

During the term of the HCP, the bypass system will be operated continuously between April 10 and August 15. Initiation of the bypass system may occur between April 1 and April 10 if the hydro-acoustic index reaches 150 and is verified by fyke netting. The bypass can terminate after August 15 if the Hydroacoustic index declines to 250 and is verified by fyke netting. The bypass will not operate past August 31. Run timing information will be gathered for five years from March 15 to April 10 and from August 15 to September 15.

2.4.4 Spill Management For Dissolved Gas Control

The DCPUD participates in a basin-wide program which at times may require spill for the purpose of managing dissolved gas levels in the Columbia and Snake Rivers. Spill management requests are placed by the Fish Passage Center and are based in part on dissolved gas monitoring data and the observed condition of migrant juveniles and adults, along with juvenile migration monitoring data. Total dissolved gas monitoring is conducted by the DCPUD at the Wells forebay and reported every four hours from April 1 through August 31. Related data reported at the same time include spill volume, total project flow and which spill gates are open. Data are sent daily to the Fish Passage Center via the CROHMS network.

2.4.5 Fish Production Facility Operations

The two main fish hatcheries owned by the DCPUD are operated to meet production requirements specified in agreements emanating from the original FERC order and from the 1990 Settlement Agreement (Federal Energy Regulatory Commission 1990; Douglas County Public Utility District 1969; 1972; 1982). The DCPUD has entered into formal arrangements with the Washington Department of Fish and Wildlife (WDFW) to have that agency operate the Methow and Wells facilities. The Colville Tribe operates the experimental Cassimer Bar facility. The WDFW and the Colville Tribe are responsible for the day-to-day hatchery activities of their respective sites and for assuring that the production programs are operated in a manner consistent with the policies and guidelines of the state. It is the ultimate responsibility of the DCPUD, however, to make certain that the objectives of the mitigation agreements are achieved.

The 1994 production goals for the DCPUD fish production facilities are noted in Table 2-8. It should be noted the fall chinook production program at Wells fish hatchery is funded by other entities and is not part of any DCPUD mitigation programs. The main facilities at Cassimer Bar, Methow and Wells hatcheries operate year-round with activities that include adult holding, spawning, incubation, rearing and on-site release. Each of these facilities also conducts initial rearing of fish that are transported to satellite facilities or released at off-station sites.

The Lake Osoyoos net pens served as a satellite facility for Cassimer Bar hatchery where sockeye were reared and released. However, because of concern expressed by the Canadian government about possible effect this program may have to the resident population of kokanee, the net pens were moved to Rufus Woods lake in 1998. The Chewuch and Twisp Ponds provide acclimation and release sites for two of the races/demes involved in the Methow River Spring Chinook Enhancement Program. These sites also have adult trapping facilities for collecting stock-specific brood.

Anadromous fish released from the DCPUD hatchery facilities share portions of the migration corridor used by Snake River species listed under the ESA. As facility operators, WDFW has obtained a Section 10 permit for all of its non-federally funded hatcheries in the Columbia Basin, including the Methow and Wells hatcheries. The permit describes efforts made by the agency to avoid and minimize impacts to listed species. These efforts include protocols for adult collection and spawning, rearing and release strategies, fish health management programs and environmental monitoring.

Table 2-8. Fish production goals for Wells dam mitigation hatcheries.
PLACEHOLDER
Diana - this table needs edits made to it.